

## REMARKS ON THE MK SYSTEM\*

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### 1. THE MK SYSTEM

#### 1.1 In Spectral Range

The principal domain for the determination of the fundamental reference stars is K - H $\beta$  (3930 - 4860 Å/mm). A certain amount of classification has been carried out in the visual and near ultra-violet regions; however, in neither case has a serious attempt been made to go to the practicable limit in accuracy. It can thus be said that the "field" for the determination of the fundamental MK standards has been K - H $\beta$ .

#### 1.2 In Dispersion of Spectrograms

By far the greatest number of precise Yerkes MK types have been determined from spectrograms having dispersions between 100 - 130 Å/mm. This scale was selected for two reasons: (1) Good accuracy can be obtained from considerably widened spectra; and (2) it is possible to obtain spectrograms of closely comparable quality over a large range in apparent magnitude. If we were starting from the beginning at present, we might choose to standardize on a somewhat higher dispersion (65 - 85 Å/mm); this could now be feasible because of the tremendous increase in sensitivity achieved in recent years. The greatest difficulty in classification at present with the lower dispersion is for stars in the spectral interval B5 - A2.

\* These comments are based on consideration of spectra earlier than the Sun. The Keenan-McNeil Atlas of Spectra of the Cooler Stars should be consulted for the classification of stars of later type.

As far as Yerkes work up to -- and including -- the almost-completed MAT Atlas is concerned, it can be considered that the MK domain is defined in terms of photographic emulsions, within the spectral range mentioned above.

2. DOES THE MK SYSTEM REPRESENT THE HIGHEST PRECISION IN CLASSIFICATION OBTAINABLE AT THE PRESENT TIME?

As stated above, the MK system is based on spectrograms of relatively low dispersion; this procedure is a compromise between high accuracy in classification and the ability to obtain similar spectrograms over a wide magnitude range. We are concerned with two factors: satisfactory precision in classification and absence of appreciable systematic errors depending on stellar magnitude.

The MK system (as defined by the new Yerkes KPNO Atlas) can be considered to be a rather precise one, in that it is defined by an array of standard stars -- and in that provision is made for the attachment of localized third dimensions to include categories that do not fit into a two-dimensional array. The accidental errors in spectral classification could be reduced in size by the use of spectrograms of high dispersion; in this case, the greatest precision could probably be obtained from the use of measured equivalent widths and line depths of all spectral lines, over as wide a range in wavelength as possible. The use of such material for classification should be based directly on the measured quantities themselves -- not in the language of derived stellar atmospheres.

3. WHAT IS THE RANGE IN APPLICABILITY OF THE MK SYSTEM?

The MK system has never been completed to include the weak-lined stars; as it now stands, it is directly applicable to strong-lined stars in the solar neighborhood -- say 2 kpc. It should be possible to create a unitary system for weak-lined stars in such a manner that the derived system could be attached to the MK array.

When distant stars are observed in our Galaxy the resulting types seem to be includable in the MK system -- except in the case of stars of uniquely high luminosity, for which there may be no nearby counterparts.

In the Magellanic Clouds, some spectra show systematic differences from those near the Sun. We do not consider such apparitions as questioning the validity of the MK system; it seems obvious that in galaxies in differing states of evolution systematic spectroscopic effects will be found. In such situations, the most satisfactory procedure would be to invent a new, unitary classification based on such families of spectra; after this has been carried out, the new

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array should confront the MK array -- and proper conclusions drawn from the confrontation.

4. WHAT IS THE "AUTHORITY" OF THE MK SYSTEM?

The MK system has no authority whatever; it has never been adopted as an official system by the International Astronomical Union -- or by any other astronomical organization. Its only authority lies in its usefulness; if it is not useful, it should be abandoned.

In this connection, there is an important point concerning the usefulness of morphological systems in general: Such systems cannot be definitive in nature if the field of specimens is incompletely explored. A good example of this is furnished by attempts to use the classical Hubble form-classification system for the classification of galaxies which were found later to be strong radio sources. There is no doubt that the MK classification system should be described as a preliminary system; by doing so, we increase the possibility of its having a useful life in future decades of astronomical research.